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PRELIMINARY RESULTS FROM CYCLE VIII OF THE CATTLE GERMPLASM EVALUATION PROGRAM AT THE ROMAN L. HRUSKA U.S. MEAT ANIMAL RESEARCH CENTER[1]

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INTRODUCTION

It is important to match genetic potential of cow herds with the climatic environment and feed resources available for beef production in diverse regions of the U.S. and with consumer preferences for beef products that excel in consistency, leanness, palatability and tenderness. Since 1969, the Germplasm Evaluation Program at the U.S. Meat Animal Research Center has been conducted to characterize breeds representing diverse biological types for a wide spectrum of biological traits of economic importance in beef production. Previous results have shown that *Bos indicus* X *Bos taurus* (e.g., Brahman and Sahiwal, sired F1 cross cows out of Hereford and Angus dams) were exceptionally productive and efficient cows, especially in subtropical climates (e.g., Florida versus Nebraska). However, as the proportion *Bos indicus* increased the advantages of *Bos indicus* crosses were tempered by older age at puberty and reduced meat tenderness. This report focuses on characterization of alternative sources of tropically adapted germplasm compared to Angus and Hereford sired crosses.

PROCEDURES

The Germplasm Evaluation Program has been conducted in eight cycles. Table 1 shows the mating plan for each cycle. Each cycle has spanned 9 or 10 years from the time sires were mated by artificial insemination (AI) until the resulting F1 females were evaluated for components of lifetime production. Angus and Hereford sires have been used in each cycle of the Program to provide ties with respect to breed and sires within breed for analysis of data pooled over cycles. In cycle VIII, Angus and MARC III females were mated by AI to sires of the following breeds:

Angus. Semen from 22 Angus sires were used in cycle VIII. Nine of the sires had been used previously in cycles VI or VII and 13 were used for the first time in cycle VIII. Half of the sires ranked in the top 100 (4 repeated sires and 7 new sires) in registrations within the Angus breed. The remainder were young unproven sires, considered to be outstanding herd sire prospects. Average expected progeny differences (EPDs) from the 2005 genetic evaluations of the Angus bulls used were 2.2, 37, 73, and 20 for birth weight, weaning weight, yearling weight and milk, respectively. Birth year 2003 breed average EPDs were 2.4, 37, 68, and 19 for birth weight, weaning weight, yearling weight, and milk, respectively (2003 is the most recent birth year of individuals with complete actual yearling weight records available for the 2005 genetic evaluations).

Hereford. Semen from 22 Hereford bulls was used in cycle VIII (11 polled and 11 horned). Ten of the sires had been used in cycles VI or VII and 12 were used for the first time in cycle VIII of the program. Half of the sires ranked in the top 100 sires in registrations within the Hereford breed at the time of sampling. The remainder were young unproven bulls. Average EPDs from the 2005 genetic evaluations of the Hereford bulls used were 3.6, 37, 65, and 16 for birth weight, weaning weight, yearling weight and milk, respectively. Birth year 2003 breed average EPDs for Herefords

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were 3.7, 36, 61, and 14 for birth weight, weaning weight, yearling weight, and milk, respectively.

Brangus. Semen from 21 Brangus bulls was used. About half of the bulls represented the top 50 most widely used sires of the breed according to registrations, and half were young, unproven sires. Brangus are a composite breed (5/8 Angus and 3/8 Brahman) developed in the U.S. that ranks ninth among beef breeds in registrations (National Pedigreed Livestock Council Annual Report 2003-2004). Average EPDs from the 2005 genetic evaluations of the Brangus sires for birth weight, weaning weight, yearling weight, and milk were 2.3, 27, 43, and 5 compared to birth year 2003 breed averages of 2.0, 23, 38, and 10, respectively.

Beefmaster. Semen from 22 Beefmaster bulls was used. About half of the bulls represented the top 50 most widely used sires of the breed and half were young, unproven sires. Beefmasters also are a composite breed (approximately 1/2 Brahman, 1/4 Hereford, and 1/4 Shorthorn) developed by the late Mr. Tom Lasater. Beefmasters rank tenth among beef breeds in registrations in the U.S. (National Pedigreed Livestock Council Annual Report 2003-2004). Average EPDs from the 2005 genetic evaluations of the Beefmaster sires for birth weight, weaning weight, yearling weight, and milk were 0.7, 14, 23, and 1 compared to birth year 2003 breed averages of 0.4, 6, 11, and 2, respectively.

Bonsmara. Semen from 19 Bonsmara bulls was used. Bonsmara are a composite breed that was developed in South Africa from 50% Africaner (an African Sanga breed), 25% Hereford, and 25% Shorthorn foundation matings. The semen was purchased from Mr. George Chapman, Amarillo, TX who imported the breed into the United States.

Romosinuano. Semen from 20 Romosinuano bulls was used. The Romosinuano breed was developed primarily in Colombia and introduced into the U.S. from Venezuela at the Subtropical Agricultural Research Station (STARS), ARS, USDA and University of Florida, Brooksville, FL. The Romosinuano is considered a Criollo (domestic) breed of Central America that traces back to *Bos taurus* cattle introduced from Europe about 400 to 500 years ago. They are believed to have become reasonably adapted to tropical conditions.

Management. Calves were born in mid-March through mid-April of 2001 and 2002. Male calves were castrated within 24 hours of birth. In 2001, calves were weaned in early October at an average of 193 days of age. In 2002, due to drought, calves were weaned early in September at a relatively young 153 days of age.

Steers. Following a postweaning adjustment period of about 30 days, steers were assigned to replicated pens within sire breed and fed separately by sire breed for an average of 255 days. For the first 26 days following weaning a diet comprised of 43.6% ground alfalfa hay, 34.0% corn, 20.0% corn silage, and 2.4% liquid supplement containing about 2.55 Mcal ME/kg dry matter and 14.25% crude protein was fed. For a short transition period of about 7 days, a diet comprised of 22.9% ground alfalfa, 31.5% corn, 43.0%, and 2.6% liquid supplement containing 2.64 Mcal ME/kg dry matter and 12.46% crude protein was fed. Following this adjustment period, after steers had been assigned to pens and feed intake recording was initiated, steers were fed a diet comprised of corn silage (66%), high moisture corn (29.5%) and liquid supplement (4.5%) containing about 2.73 Mcal ME/kg dry matter and 11.81% crude protein until late January. The percentage of high moisture corn gradually increased and corn silage was reduced over a 2-week period in late January and early February. The finishing diet fed from February (when steers weighed about 700 lb) to slaughter contained about 3.05 Mcal ME/kg dry matter and 13.1% crude protein. Steers were implanted with Synovex S (200 mg progesterone and 20 mg estradiol benzoate) in mid-December and again in mid-March.

Steers were slaughtered serially in four (2002) or five (2003) slaughter groups spanning 35 days (May and June). The steers were slaughtered in a commercial facility. Hot carcass weights were obtained and used to estimate dressing percent (100 x carcass weight/final live weight). After a 36-hour chill, USDA yield grade (fat thickness, ribeye area, estimated % kidney, pelvic, and heart fat, carcass weight) and quality grade (marbling, maturity) data were obtained. The wholesale rib from the right carcass side was transferred to the meat laboratory at MARC and separated into lean, fat trim, and bone. Retail product, fat trim, and bone from the right side was estimated using wholesale rib dissection prediction equations derived from steers produced previously in the GPE Program (Shackelford et al., 1995). After 15 days of postmortem aging, Warner-Bratzler shear force and trained sensory panel ratings of tenderness, beef flavor intensity, and juiciness were determined on cooked ribeye steaks.

Females. After weaning in the fall at about 7 months of age, the female progeny of Bonsmara, Beefmaster, Brangus, and Beefmaster sires were

divided into two groups with about equal numbers per sire and sire-dam group. For about 4 weeks they were fed a diet comprised of 43.6% ground alfalfa hay, 34.0% corn, 20.0% corn silage, and 2.4% liquid supplement containing about 2.55 Mcal ME/kg dry matter and 14.25% crude protein. Then for about one week a diet comprised of 22.9% ground alfalfa, 31.5% corn, 43.0%, and 2.6% liquid supplement containing 2.64 Mcal ME/kg dry matter and 12.46% crude protein was fed. At about 8 months of age, females by Bonsmara, Beefmaster, Brangus, and Beefmaster sires were divided into two groups with about equal numbers per sire-breed and sire-dam breed group, half were transferred to Louisiana State University and half remained at MARC to evaluate genotype-environment interaction for reproduction and maternal performance in temperate and subtropical environments. Only data obtained at MARC are included in this report. Heifers that remained at MARC were assigned to three pens each year containing about 70 head per pen. Each sire breed was represented in each pen approximately proportional to their overall frequency. For about 138 days they were fed a diet comprised of 30% alfalfa haylage and 70% corn silage containing 2.43 Mcal ME/ kg dry matter and 12.97 % crude protein. Then they were fed a diet comprised of 70% alfalfa haylage and 30% corn silage and containing 2.16 Mcal ME/kg dry matter and 12.97% crude protein until they were moved from the dry lot to grass pastures in mid-May of each year. Heifers were observed twice daily for estrus beginning on January 2 each year. Surgically altered teaser bulls, rotated weekly, were used to promote estrus behavior and aid in estrus detection. Weights were taken at 56 day intervals from weaning to the beginning of the breeding period. Heifers were exposed to MARC III bulls for 63 days beginning on May 20, 2002 and May 21, 2003. Body weights were recorded at the beginning and end of the breeding season. The heifers were pregnancy tested and weights and hip heights were recorded on August 29, 2002 and October 24, 2003.

The females were maintained on predominantly cool season smooth brome grass pastures from mid-May through mid-June and later from mid-September through October. In mid-June to mid-September they were run on warm season mixtures of big blue stem, Indian grass, switchgrass, with some little bluestem, sideoats grama, and sand love grass. During winter months, the heifers were supplemented with alfalfa hay and corn silage while on pasture.

At 2 years of age, the females born in 2001 produced their first calves from February 18 through May 2, 2003 and those born in 2002 produced their first calves from February 17 through May 5, 2004. Their calves were weaned on September 24 at an average age of 189 days in 2003 and a bit earlier due to drought conditions on September 10, 2004 at an average age of 177 days.

The females have been exposed to Charolais bulls to produce their subsequent calves from 3 years of age through mature ages (8 years of age). Data in this report are preliminary, including records only through 4 years of age for the females born in 2001 and 3 years of age for those born in 2002. Calves were born from March 8 through May 25 in 2004 and from February 23 through May 24, in 2005. Due to drought conditions, calves were weaned on September 20 at an average age of 168 days in 2004 and on September 16, 2005 at an average age of 167 days.

Data Analyses. Preweaning data for calving and survival traits recorded on all calves born were analyzed by least squares procedures using a model that included a random effect for sires nested in breed of sire and the fixed effects for sire breed, dam breed, age of dam (4, 5 to 8, and ≥ 9 yr), year of birth, sex of calf, sire breed-dam breed and if significant, other two factor interactions (i.e., sire breed-sex of calf for calving traits and for survival, no other two factor interactions were significant for 205 d weaning weight).

Postweaning growth and carcass data on steers were analyzed by least squares procedures using a model that included fixed effects for sire breed, dam breed, age of dam, and interactions of sire breed-dam breed, a random effect of sire within breed of sire, and covariates for weaning age and days fed postweaning. For analysis of feed efficiency, regression of marbling score, fat thickness, fat trim percentage, and retail product weight on days on feed was used to estimate days required to reach a marbling (Small00, the minimum level of marbling required for the USDA quality grade, Low Choice), fat thickness (0.39 in, the overall mean), fat trim (24.6 fat trim, the overall mean), or weight of retail product (467 lb, the overall mean) endpoint. Quadratic regression of pen mean weights on days fed and of cumulative metabolizable energy (ME) on days fed were used to estimate pen mean gain, ME consumption and efficiency (lb gain/ Mcal ME) in time (0 to 186 days) and weight (649 to 1190 lb) intervals or from the starting date (day 0) to a marbling (Small00), fat thickness (0.39 in), fat trim (24.6% fat trim) or

weight of retail product (RP = 467 lb) endpoint. Estimates of pen mean efficiencies (2 pens per sire breed per year) for each interval and endpoint were analyzed by analysis of variance considering sire breed (df =5), year (df = 1) and residual (df = 17) sources of variation. Sire breed-birth year interaction was not a significant source of variation for any estimate of efficiency. Thus, the residual mean square was used as the error variance for estimates of least significant differences for (LSD<.05) among estimates of sire breed means for feed efficiency.

Data on postweaning growth and puberty traits of heifers were analyzed by least squares procedures using a model that included a random effect for sires nested in breed and fixed effects for sire breed, dam breed, year of birth, age of dam, and sire breed-dam breed, and if significant, other two factor interactions. The average least significant difference (LSD < 0.05) among sire breed contrasts (using sire within breed mean square as the error term) was used to assess sire breed differences. Differences as large as or larger than LSD < 0.05 are expected to result from chance only 5 times out of 100 in experiments of the same magnitude.

Preliminary Results

Estimates of sire breed means averaged over Angus and MARC III dams are shown in Table 2 for preweaning traits. Breed of sire means for postweaning growth rate and final weight of steers and some carcass traits adjusted to 426 days of age are provided in Table 3. Breed of sire means for estimates of carcass composition, and for meat tenderness and sensory traits are provided in Tables 4 and 5. Breed of sire means for estimates of efficiency of live weight gain are shown in Table 6 for alternative intervals and endpoints. Data for postweaning growth and puberty traits of heifers are summarized in Table 7. Breed of sire of dam means for reproduction and maternal performance of females mated to MARC III bulls are shown in Table 8. Data summarized for reproduction and maternal performance of F1 cows at subsequent ages (Table 9) are preliminary representing only the first 2 of 7 calf crops to be produced by the females when they are mated to Charolais sires to produce progeny from 3 through 8 years of age. Differences shown in the tables for breed of sire, estimate one-half of the genetic differences between breeds because comparable Angus and MARC III dams were used to produce all progeny.

Preweaning traits. Analysis of variance indicated that breed of sire effects were significant (P < .01) for gestation length, birth weight, and 205-day weaning weight, but not for percentage unassisted births, calving difficulty score, or survival from birth to weaning. Gestation length was significantly less for progeny of Angus sires than for progeny of any other breed. Hereford and Brangus, which did not differ significantly in gestation length, had significantly shorter gestation lengths than Beefmaster or Bonsmara. Gestation length was significantly longer for progeny of Romosinuano sires than for progeny of any other sire breed. Romosinuano sired progeny were significantly lighter at birth than those of any other breed except Angus. Angus sired progeny were lighter at birth than those with Bonsmara, Brangus, or Hereford sires. Birth weight did not differ significantly among progeny of Bonsmara, Brangus and Hereford sires. Progeny of Beefmaster sires were significantly heavier at birth than those of any other sire breed. Weaning weight at 205 days was significantly heavier for progeny of Beefmaster sires than for any other sire breed, followed by Brangus and Angus which did not differ significantly. Brangus were significantly heavier at weaning than Hereford sired progeny. Angus, Hereford and Bonsmara sire breeds did not differ significantly in weaning weight. Romosinuano sired progeny were significantly lighter at weaning than those of any other sire breed.

Postweaning growth and carcass traits of steers. Postweaning average daily gain was similar among Angus and Beefmaster sired steers. Angus sired steers had greater postweaning average daily gain than steers of all sire breeds except Beefmaster. Romosinuano and Bonsmara sired steers had the lowest postweaning average daily gain and the lightest slaughter and carcass weights adjusted to 426 days of age. Angus and Beefmaster sired steers had the heaviest slaughter and carcass weights. Dressing percentages were higher for Bonsmara and Brangus than for Beefmaster and Hereford sire breeds. Marbling score and percentage of carcasses grading at least USDA Choice were higher for carcasses from Angus sired steers than for steers from all other sire breeds. USDA yield grade was higher (lower yielding) for carcasses from Angus and Beefmaster sired steers, and lower (higher yielding) for Romosinuano and Bonsmara cross steers. Romosinuano, Bonsmara, Hereford, and Brangus sire breeds had carcasses with lower adjusted fat thickness than did Angus and Beefmaster sire breeds. Despite having lighter carcass weights, carcasses from Bonsmara sired steers had larger ribeye areas than carcasses from

Hereford, Angus, and Beefmaster sired steers. Kidney, pelvic, and heart fat (KPH) percentage was higher in carcasses from Angus than for Hereford sired steers.

The percentage of carcass as retail product was highest in carcasses from Romosinuano and Bonsmara sired steers, intermediate in Beefmaster, Brangus, and Hereford sired steers, and lowest in carcasses from Angus sired steers. Weight of retail product was greater for carcasses from Beefmaster and Brangus than for Bonsmara, Hereford, and Romosinuano sired steers. Carcasses from Romosinuano sired steers had the lowest percentage and lightest weight of fat trim. Carcasses from Angus sired steers had the highest percentage of fat trim; and, carcasses from Angus and Beefmaster sired steers had heavier weight of fat trim than carcasses from other sire breeds. The percentage of the carcass as bone was lower for carcasses from Angus sired steers than for carcasses from all other sire breeds except Bonsmara. The weight of bone was lightest for carcasses from Bonsmara and Romosinuano sired steers and heaviest for carcasses from Brangus and Beefmaster sired steers.

Warner-Bratzler shear force indicated that ribeye steaks from carcasses of Angus-sired steers were more tender than those from Beefmaster- and Brangus-sired steers. Trained sensory panel tenderness ratings were lower for ribeye steaks from carcasses of Beefmaster-sired steers than for those from Bonsmara- and Angus-sired steers. Beef flavor ratings were higher for ribeye steaks from carcasses of Angus-sired steers than those from all other sire breeds except Hereford and Bonsmara. Juiciness ratings were higher for ribeye steaks from carcasses of Angus-sired steers than those from all other sire breeds except Hereford.

Feed Efficiency. Breed of sire differences were significant for efficiency of postweaning live weight gain for all intervals and endpoints (Table 6). Efficiency of gain was significantly greater for Angus and Hereford than for tropically adapted Romosinuano or Bonsmara for every interval evaluated. Angus and Hereford sired steers did not differ significantly for efficiency of gain for any interval evaluated. Beefmaster and Brangus sired steers did not differ in efficiency of gain for any interval evaluated. Beefmaster sired steers did not differ significantly for efficiency of gain from Angus or Hereford sired steers in any interval except to the marbling endpoint. Angus were significantly more efficient than Beefmaster to the marbling endpoint. Brangus were intermediate in efficiency of live weight gain to the British (Angus and Hereford) and Tropically adapted (Romosinuano and Bonsmara) sire breeds for all intervals evaluated. Brangus did not differ significantly from Beefmaster, Hereford, or Angus in any interval evaluated except that Angus were more efficient than Brangus to all fatness endpoints (marbling, fat thickness, and fat trim). Beefmaster and Brangus sired steers were significantly more efficient than Bonsmara sired steers to live weight, fatness, and retail product weight endpoints. However to a time endpoint (186 days), Brangus did not differ significantly from Romosinuano or Bonsmara, and Beefmasters did not differ significantly from Romosinuano. Romosinuano did not differ from Bonsmara for feed efficiency for any interval evaluated, except for the marbling endpoint, to which efficiency of gain was greater for Romosinuano than Bonsmara sired steers. Previous results have indicated that efficiency of postweaning gain is greater for steer progeny of *Bos taurus* sire breeds (e.g., Angus and Hereford) than for those of tropically adapted *Bos indicus* sire breeds (Brahman, Nellore, and Sahiwal) when the postweaning period includes winter months (December through March), as in the present study.

Postweaning growth and puberty traits of heifers. Data summarizing growth and puberty characteristics of females are shown in Tables 7. Results for growth of heifers are generally consistent with that of steers indicating that Beefmaster and Angus sired females had the greater growth rates to 400 days than all other sire breeds except Brangus. By 400 days, Brangus and Herefords did not differ significantly in body weight, but both were heavier than Bonsmara or Romosinuano sired females. By 18 months of age, after the summer gazing season, Beefmaster were significantly heavier than all other breeds except Brangus. Brangus sired heifers were significantly heavier at 18 months of age than Romosinuano sired females, but did not differ significantly from Hereford, Bonsmara or Angus sired females, which had similar 18 month weights. Brangus and Beefmaster sired heifers had significantly greater hip heights and frame scores at 18 months of age than Hereford, Bonsmara, Angus, or Romosinuano sired heifers. Hereford sired heifers ranked third in hip height and frame score and were significantly taller than Romosinuano sired heifers. Bonsmara, Angus, and Romosinuano sired heifers did not differ in hip height or frame score at 18 months of age.

Analysis of variance indicated that effects of sire breed were significant for age at puberty but

not for pregnancy rate. Females by Angus sires reached puberty at a significantly younger age than those by any other sire breed. Hereford sired females ranked second and were significantly younger at puberty than Beefmaster and Bonsmara sired females which did not differ significantly. Females by Romosinuano sires reached puberty at significantly older ages than females by any other sire breed except Bonsmara.

Reproduction and Maternal performance. Sire breed means for reproduction and maternal performance of females as 2-yr-olds are summarized in Table 8. Analysis of variance indicated that effects of sire breed of dam were not significant for calf crop percentages at birth or weaning, calving difficulty score, birth weight or calf survival from birth to weaning, but were significant (P<.05) for percentage unassisted calvings, 200-day weight per calf weaned, and 200-day weight weaned per cow exposed. Romosinuano sired females required significantly less assistance at calving than Bonsmara sired females calving at 2 years of age. Calves produced by Romosinuano sired 2-year-old females tended to have lighter birth weights than those by any other sire breed. Females sired by Beefmaster and Brangus sires weaned significantly heavier calves than those by Bonsmara, Hereford, or Romosinuano sires. Angus sired females did not differ from Beefmaster, Brangus, or Bonsmara sired females for maternal weaning weight, but did wean significantly heavier calves than Hereford or Romosinuano sired females. Bonsmara and Hereford sired females did not differ significantly for maternal weaning weight, but both weaned heavier calves than Romosinuano sired females. Reproduction rate and maternal weaning weight are reflected in 200-day weight per cow exposed. This estimate of productivity was significantly greater for Beefmaster and Brangus sired females than for Angus, Romosinuano, or Bonsmara sired 2-year-old females. Hereford, Angus, Romosinuano, and Bonsmara sired females did not differ significantly for 200-day weight per cow exposed.

Preliminary data for reproduction and maternal performance to be evaluated through mature ages are shown in Table 9 for females at 3 and 4 years of age. Effects of sire breed were significant for birth weight, unassisted births, and 200-day weaning weights of progeny but not for calf crop percentages born or weaned, calf survival from birth to weaning, or 200-day weaning weight per cow exposed to breeding. Beefmaster and Hereford sired females had significantly more unassisted calvings than Bonsmara sired females. No other breed groups differed significantly for percentage unassisted calvings. Birth weights of progeny did not differ among Hereford, Brangus, and Angus dams, all of which produced calves with significantly heavier average birth weights than Romosinuano sired dams. Beefmaster sired dams birthed significantly lighter calves than Hereford or Brangus dams. Birth weights of progeny did not differ significantly for Beefmaster, Bonsmara, and Romsinuano sired dams. Compared to Hereford and Angus, Beefmaster sired calves were relatively heavy at birth (Table 2), but Beefmaster sired dams produced calves with relatively light birth weights (Table 8 and 9). Results for Beefmasters (a composite with approximately 50% Brahman, 25% Hereford, and 25% Shorthorn inheritance) are consistent with previous results indicating that relative to *Bos taurus* breeds, direct breed effects that increase birth weight of calves by *Bos indicus* sires (e.g., Brahman) are offset by maternal breed effects that reduce fetal growth and development of calves with *Bos indicus* sired dams. The pattern for Brangus (a composite breed with 5/8 Angus and 3/8 Brahman inheritance) reflects a strong direct effect on birth weight of Brangus sired calves (Table 2), but the *Bos indicus* maternal effect that reduces birth weight in progeny of females may be less for Brangus than for Beefmaster sired females (Tables 8 and 9).

Mean maternal weaning weights for Brangus, Angus, and Beefmaster sired females calving at 3 and 4 years of age did not differ significantly (Table 9). Brangus sired females weaned significantly heavier calves than Hereford or Romosinuano sired females. Mean maternal weaning weights for 3 and 4 year olds were not significantly different for Angus, Beefmaster, Hereford, and Bonsmara sired females, but all were significantly heavier than that for Romosiuano sired females.

TABLE 1. SIRE BREEDS USED IN GERMPLASM EVALUATION PROGRAM AT MARC

Cycle I (1970-72)	Cycle II (1973-74)	Cycle III (1975-76)	Cycle IV (1986-90)	Cycle V (1992-94)	Cycle VI (1997-98)	Cycle VII (1999-2000)	Cycle VIII (2001-2002)
F_1 crosses (Hereford or Angus dams)[a]							
Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
Angus	Angus	Angus	Angus	Angus	Angus	Angus	Angus
Jersey	Red Poll	Brahman	Longhorn	Tuli	Wagyu	Red Angus	Brangus
S. Devon	Braunvieh	Sahiwal	Salers	Boran	Norwegian Red	Limousin	Beefmaster
Limousin	Gelbvieh	Pinzgauer	Galloway	Belgian Blue	Swedish Red&White	Charolais	Bonsmara
Simmental	Maine Anjou	Tarentaise	Nellore	Brahman	Friesian	Simmental	Romosinuano
Charolais	Chianina		Shorthorn	Piedmontese		Gelbvieh	
			Piedmontese				
			Charolais				
			Gelbvieh				
			Pinzgauer				
3-way crosses out of F1 dams							
Hereford	Hereford						
Angus	Angus						
Brahman	Brangus						
Devon	Santa Gertrudis						
Holstein							

[a]Composite MARC III cows (1/4 each Angus, Hereford, Red Poll and Pinzgauer) also were included in Cycles V, VI, and VII. MARC III cows completely replaced Hereford cows in Cycle VIII.

TABLE 2. SIRE BREED LEAST SQUARES MEANS FOR PREWEANING TRAITS OF F_1 CALVES

Sire breed of calf	No. calves born	Gestation length days	Calvings unassist., %	Calving diff. score	Birth wt., lb.	Survival to wn., %	205-d wn. wt., lb.
Hereford	212	283.7	94.4	1.33	91.1	96.9	534
Angus	208	281.6	97.2	1.19	87.1	98.1	541
	420	282.6	95.8	1.26	89.1	97.5	538
Brangus	214	284.9	96.9	1.19	90.5	96.8	549
Beefmaster	222	286.6	95.6	1.23	95.5	96.4	560
Bonsmara	207	286.7	97.7	1.10	90.4	94.7	533
Romosinuano	207	288.9	99.2	1.05	84.7	98.6	507
LSD < 0.05		1.6	3.4	0.20	3.0	3.3	10.9

TABLE 3. SIRE BREED LEAST SQUARES MEANS FOR POSTWEANING GROWTH AND CARCASS TRAITS OF F1 STEERS (ADJUSTED TO 426 DAYS OF AGE)

Sire breed	N	Post Wn. A.D.G., lb	Slaughter weight, lb	Carcass weight, lb	Dress., %	Marb. score[a]	USDA Choice, %	USDA Yield grade	Adj. Fat thick., in	Ribeye area, sq. in	KPH fat, %
Hereford	102	3.02	1245	757	60.8	515	51.6	2.90	0.44	12.43	2.03
Angus	103	3.15	1283	783	61.0	548	68.9	3.17	0.51	12.63	2.26
Average	205	3.08	1264	770	60.9	531	60.3	3.04	0.48	12.53	2.15
Brangus	107	2.99	1256	774	61.6	497	47.4	2.69	0.39	13.04	2.20
Beefmaster	103	3.10	1296	789	60.8	483	32.1	3.10	0.48	12.53	2.12
Bonsmara	104	2.80	1185	729	61.5	487	38.9	2.42	0.36	13.08	2.19
Romosinuano	102	2.71	1150	702	61.0	488	33.7	2.31	0.31	12.72	2.19
LSD < 0.05		0.09	30	19	0.5	24	17.0	0.24	0.06	0.41	0.18

[a]400 = Slight^{00}, 500 = Small^{00}.

TABLE 4. SIRE BREED LEAST SQUARES MEANS FOR ESTIMATED RETAIL PRODUCT, FAT TRIM, AND BONE YIELDS OF F1 STEERS (ADJUSTED TO 426 DAYS OF AGE)[a]

		Retail product		Fat trim		Bone	
Sire breed	N	%	lb	%	lb	%	lb
Hereford	101	61.8	466	24.7	188	14.5	109
Angus	103	60.1	469	27.0	212	13.9	108
Average	204	61.0	468	25.9	200	14.2	109
Brangus	105	62.1	480	24.3	189	14.6	113
Beefmaster	97	61.3	482	25.5	202	14.5	114
Bonsmara	99	63.5	464	23.8	175	14.1	103
Romosinuano	100	64.4	452	22.0	156	14.7	103
LSD < 0.05		1.1	13	1.3	12	0.3	3

[a]Estimates were from wholesale rib dissection prediction equations (Shackelford et al., 1995).

TABLE 5. SIRE BREED LEAST SQUARES MEANS FOR WARNER-BRATZLER SHEAR FORCE AND SENSORY CHARACTERISTICS OF RIBEYE STEAKS AGED FOR 15 DAYS POSTMORTEM (ADJUSTED TO 426 DAYS OF AGE)

			Sensory traits[b]		
Sire breed	N	Warner-Bratzler shear force, lb[a]	Tenderness	Beef flavor intensity	Juiciness
Hereford	101	8.1	5.77	4.61	5.53
Angus	103	7.6	5.91	4.64	5.57
Average	204	7.8	5.84	4.63	5.55
Brangus	105	8.6	5.72	4.53	5.47
Beefmaster	97	9.0	5.66	4.55	5.46
Bonsmara	99	8.1	5.86	4.57	5.46
Romosinuano	100	8.3	5.79	4.54	5.48
LSD < 0.05		0.5	0.17	0.07	0.07

[a]Lower shear force values reflect greater tenderness.
[b]Sensory traits: 1 = extremely tough, bland, or dry through 8 = extremely tender, intense, or juicy.

TABLE 6. SIRE BREED MEANS FOR ESTIMATES OF EFFICIENCY (LIVE WEIGHT GAIN PER UNIT METABOLIZABLE ENERGY CONSUMED, lb/Mcal) FOR ALTERNATIVE INTERVALS AND ENDPOINTS

Sire breed	Time 186 days	Weight 649-1190 lb	Marbling Small 00	Fat thickness .39 in	Fat trim 24.6%	Retail Product 467 lb
Angus	0.1319	0.1363	0.1389	0.1366	0.1364	0.1322
Hereford	0.1313	0.1335	0.1332	0.1330	0.1315	0.1311
Brangus	0.1282	0.1326	0.1277	0.1282	0.1276	0.1307
Beefmaster	0.1319	0.1364	0.1297	0.1346	0.1333	0.1340
Bonsmara	0.1226	0.1223	0.1204	0.1208	0.1210	0.1218
Romsinuano	0.1278	0.1260	0.1269	0.1254	0.1252	0.1266
LSD < .05	0.0058	0.0066	0.0061	0.0066	0.0066	0.0062

TABLE 7. BREED GROUP MEANS FOR GROWTH AND PUBERTY TRAITS OF HEIFERS

Sire breed of female	N	400-d weight, lb.	18 month weight, lb.	18 month height, cm	Frame score[a]	Puberty expressed %	Puberty weight lb	Age at puberty Act. d	Age at puberty Adj. d	Preg. rate, %
Hereford	102	854	889	127.7	5.41	94.9	736	324	329	85.4
Angus	107	881	880	126.3	5.12	97.8	743	312	310	82.7
Average		868	885	127.0	5.26	96.4	739	318	320	84.1
Brangus	47	870	904	129.3	5.74	86.9	763	333	341	91.9
Beefmaster	53	884	923	129.1	5.69	88.5	782	338	350	96.3
Bonsmara	51	832	889	126.7	5.20	86.0	751	347	352	84.4
Romosinuano	50	766	821	126.1	5.09	85.9	717	352	362	89.4
LSD < 0.05		26	25	2.1	0.24	10.0	30	13	16	11.2

[a] Frame scores were calculated from height using the equation recommended in Guidelines for Uniform Beef Improvement Programs, Beef Improvement Federation (BIF, 2002).

TABLE 8. SIRE BREED MEANS FOR REPRODUCTION AND MATERNAL TRAITS OF F1 FEMALES MATED TO PRODUCE THEIR FIRST CALVES AT 2 YEARS OF AGE (2001 AND 2002 CALF CROPS)

Sire breed of female	No.	Calf crop born %	Calf crop wnd. %	Calving diff. score	Unassist births %	Birth wt. lb.	Surv. to wean. %	200-d wt. per calf lb.	200-d wt. per cow exp. lb.
Hereford	101	81.4	76.5	1.72	75.4	79.2	93.7	452	345
Angus	104	78.1	69.0	1.65	77.3	77.6	88.2	474	325
Average		79.8	72.8	1.68	76.4	78.4	90.9	463	335
Brangus	45	88.1	85.1	1.48	84.0	78.8	95.8	480	407
Beefmaster	51	93.6	86.1	1.59	82.8	77.5	91.9	486	417
Bonsmara	48	80.5	69.0	2.12	60.2	77.7	85.9	455	317
Romosinuano	50	81.8	79.2	1.28	88.4	73.7	96.2	415	328
LSD<.05		13.0	15.8	.58	16.0	3.8	11.2	22	73

TABLE 9. SIRE BREED MEANS FOR REPRODUCTION AND MATERNAL TRAITS OF F1 FEMALES MATED TO CHAROLAIS SIRES TO PRODUCE CALVES AT 3 AND 4 YEARS OF AGE (2004 AND 2005 CALF CROPS)

Sire breed of female	No.	Calf crop born %	Calf crop wnd. %	Calving diff. score	Unassist births %	Birth wt. lb.	Surv. to wean. %	200-d wt. per calf lb.	200-d wt. per cow exp. lb.
Hereford	129	94.5	91.7	1.10	97.8	93.0	97.0	525	481
Angus	123	94.9	91.9	1.42	92.7	90.0	96.8	547	504
Average		94.7	91.8	1.26	95.2	91.5	96.9	536	492
Brangus	65	92.8	88.0	1.27	92.7	92.0	94.6	553	489
Beefmaster	72	96.5	94.3	1.03	98.3	87.5	97.7	539	510
Bonsmara	57	95.3	89.6	1.37	90.6	88.3	93.9	524	478
Romosinuano	66	99.5	97.0	1.21	94.4	85.2	97.4	480	469
LSD<.05		6.6	7.9	0.33	6.0	4.0	5.0	24	46